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CONSUMER PRODUCTS PACKAGING
AND THE
REDUCTION OF SOLID WASTE

GOVERNMENT DOCUMENTS
COLLECTION

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CONTENTS

Page

USAGE AND COSTS OF PACKAGING 1

RATIONALE FOR PACKAGING CONTROL 4

POLICY INSTRUMENTS FOR REDUCING PACKAGING WASTES 5

ANALYSIS OF POLICY INSTRUMENTS 10

PERSPECTIVE 13

TABLES 15

REFERENCES 20

USAGE AND COSTS OF PACKAGING

In 1973, an estimated 144 million tons of municipal solid waste were generated. Of this amount, packaging wastes from all sources were by far the largest component, contributing 52 million tons and 36 percent of the total (Table 1).[1] Of this 52 million tons of packaging waste, about 33 million tons or 64 percent came from consumer products, while the balance was from industrial and commercial products.

The cost of solid waste collection varies from city to city, depending on such factors as the quality and frequency of the collection service and the mode and quality of disposal. On the average, however, the costs for solid waste management in 1973 were estimated to be $17.97 per ton for collection and $3.99 per ton for disposal.[3] Using these values, and, based on experience, assuming that 95 percent of the solid waste generated was collected, the total cost for collection and disposal of municipal solid waste in 1973 was $3.2 billion. The solid waste management costs for all packaging totaled $1.1 billion, and the costs for consumer products packaging were about $700 million (Table 2).

These monetary expenditures for collection and disposal are only one aspect of the costs of solid waste generation. Also involved are those costs which are not incorporated into product prices, and, therefore, are paid not directly by consumers but, rather, by society as a whole. In 1970, for example, 45 million tons of raw materials and 80 billion kilowatt hours of energy were consumed in the production of consumer product

packaging (Table 3).[4] Besides requiring the heavy utilization of non-replenishable natural resources, solid waste contributes to pollution and other environmental insults.

The burden imposed on the nation's natural resources and solid waste systems by this generation and disposal of packaging waste is steadily increasing. Between 1958 and 1970 the weight of consumer products packaging increased at an average annual rate of 4.4% (Table 4).[5] Continuation of this rate would result in a doubling every 17 years. And this rate is not expected to slow in the near future. Per capita consumption of packaging, it is estimated, has increased by over 14 percent in the past six years (Table 5).[6,7]

Increases in consumer products packaging have been independent of the growth in consumption of the products being packaged. For example, the per capita consumption of food in the United States increased in weight by 2.3 percent between 1963 and 1971. During the same period, however, the weight of food packaging per capita increased by 33.3 percent. A number of specific cases may be cited. For example, between 1958 and 1970, per-capita milk consumption decreased in weight by 23.1 percent, but per-capita milk container consumption increased by 26.1 percent. In the same period, the consumption of canned vegetables increased in weight by 17.8 percent, while the weight of cans used for vegetables increased by 31.5 percent. More data on package consumption changes in relation to product consumption changes is provided in Table 6.[9] In all of these cases, increases in packaging consumption has far outstripped product consumption.

A major factor in the rapid growth of packaging is its modern use as a marketing tool. Traditionally, packaging's primary (and frequently only), function was to provide protection for products on their way to the consumer. Packaging is now also used to help sell goods by using it for advertising and by providing convenience. A package can be a persuasive force in the purchase decision for it can create product differentiation where little may actually exist. The importance of this differentiation can be seen in many drug and food stores where it is used to differentiate virtually identical products. The successful package must first gain the potential customer's attention by being visually attractive. Then, it must convince shoppers that the product will meet their needs by communicating pertinent information about the content of the package and its use. Finally, it can trigger the sale by overcoming any final resistance of the buyer.

Consumer demand for convenience has contributed to the increase in waste, and this pressure is expected to continue. This is mainly due to greater affluence and a growing percentage of women in the work force.[10] With less time for household work, this should increase the demand for consumer products that will save time, especially that spent in food preparation and cleanup. This demand has resulted in a trend toward "convenience-sized" containers.

A number of measures have been suggested to reduce the increasing rate of packaging consumption. Some of the broad-based actions that might be undertaken by federal or state government will be examined in this paper.

RATIONALE FOR PACKAGING CONTROL

The costs that producers pay for packaging (private costs) understate the costs imposed by packaging on society (social costs). The private costs of packaging, for example, do not reflect the costs to society for the collection and disposal of solid waste. Furthermore, the long-run cost to society of the natural resources used for packaging is not be fully reflected in the private costs of these resources.

The failure of the free market to reflect social costs is well illustrated by the extent to which recycled materials are now used in packaging. Neither the manufacturer's decision to make a package nor the consumer's decision to purchase that package are influenced by materials which would reduce the consumption of raw materials, might save energy, and would be environmentally less disruptive. The market does not reward either party for making or buying a package composed of recycled materials, nor are there economic sanctions attached to the use of a package which is composed solely of virgin materials.

In order to influence either the packaging industries or consumers, economic rewards would have to be attached to using recycled materials and sanctions imposed on containers composed only of virgin materials. Since neither packagers nor package buyers are likely to impose such rewards and sanctions voluntarily, the intervention of government is essential to implementing such a strategy. This could be at the federal, regional, state or municipal level.

POLICY INSTRUMENTS FOR REDUCING PACKAGING WASTES

Selection of Policy Instruments

A number of policies have been proposed to reduce the solid waste management burdens posed by the growth of packaging. Since we are concerned with the entire range of packaging (i.e., consumer, commercial, and industrial), the policy instruments discussed here are those that have potentially broad applications to all classes of packaging. The instruments selected are those studied for the Environmental Protection Administration by T.H. Bingham and his associates and can be divided into two broad classes, according to whether they are created by the law (regulation) or the market (fiscal, i.e., taxes).[12]

Regulation

Increased use of recycled materials would tend to decrease the consumption of natural resources and lessen the need for solid waste disposal sites. Thus, rational public policy would encourage the use of recycled materials.

The regulatory policy considered here would promote the recycling of solid waste by requiring that all packaging be composed of a minimum amount (by weight) of recycled materials. The regulation coxld be specific by specific material and specific products or it could be applied broadly across all packaging materials and products. Requirements of 10, 20, and 30 percent recycled material content to be uniformly applied to all packages have been selected for analysis, since these appear to be feasible alternatives.

Regulations have been the most common response of government to problems in environmental quality. Explicit regulations, supported by effective enforcement, can induce the desired behavior by industry or consumers. The converse, however, is also true because:

(a) Regulations are difficult to write in unambiguous language, and may therefore be avoided or at least delayed through the legal channels.

(b) Since obeying regulations is usually expensive, there is pressure to avoid them. As a result, the costs of effective administration and enforcement are likely to be high compared to fiscal incentives.

(c) Regulations are frequently enforced in an erratic or even lax manner.

(d) Regulations tend to interfere with the free market system and raise costs.

Fiscal Incentives

Among the several types of fiscal incentives proposed for application to problems in environmental quality, taxation has the strongest support. Taxes can be used to promote some reduction of packaging and/or resource recovery in packaging, thereby reducing the environmental problems associated with the generation, collection, and disposal of packaging solid waste.

If taxes are introduced, they would have maximum impact if imposed where the decisions are made that determine the amount and type of packaging.

The tax base selected for packaging could involve a variety of factors. For example, many alternative tax bases have been suggested, including disposability, potential for recycling, degradability, energy content, volume, weight, and natural resource content or mix. However, for some of these bases, the data necessary to determine rates do not exist. Other bases are difficult to define meaningfully. Package weight and the number of packaging units emerge from the potential tax bases as strong contenders because data are available and the social costs of packaging appear correlated with weight or units. Thus, weight and units of packaging are the bases for the fiscal incentive measures to be considered.

The three packaging taxes analyzed are:

(a) A tax on the weight of consumer products packaging. Tax rates of 9, 20, 45 and 90 dollars per ton of packaging, uniformly applied to all packages, were selected for study for this and tax (b). Tax (a) would tend to reduce the quantities of packaging, thereby conserving natural resources and reducing solid waste management costs.

(b) A tax on the weight of consumer products packaging with an exemption for materials recycled from municipal waste. Less reduction in solid waste and greater reductions in natural resource utilization would be expected from this tax than for tax (a), because there would be an incentive to only reduce use of packaging made from virgin materials but no incentive to use less recycled material.

(c) A per-unit tax on all rigid containers used to package consumer products. The uniform tax rates examined are 0.5, 1.0, 1.5, and 2.0 cents per container. This tax would tend to reduce the quantities of rigid packaging materials consumed for packaging, but its impacts are especially difficult to project since the tax may induce significant shifts to larger container sizes containing several units that were previously packaged separately.

Taxes, in theory, provide improvements in environmental quality at minimum social cost because they permit adjustments of individual purchasing patterns in the free market. If implemented, any of the regulatory and taxing measures discussed above would be expected to increase costs to consumers. Economist S.J. Baumol, discussing the advantages of a tax compared to regulation, noted:

> "... it promises to be operational because it requires far less information for its implementation. It utilizes global measures and avoids direct controls with all of their heavy administrative costs and their distortions of consumer choice and inefficiencies. It does not use the police and the courts as the prime instrument to achieve the desired modification of the outputs of the economy. Its effects are long lasting, not dependent on the vigor of an enforcement agency, which all too often proves to be highly transitory ... it need not add to the mounting financial burdens of the state and local government. Finally, it can be shown that, unlike any system of direct controls, it promises, at least in principle, to achieve decreases in pollution or other types of damage to the environment at minimum cost to society."[13]

A significant drawback to using taxes is the difficulty of predicting their outcome. While analysis prior to the institution of a tax can provide an important starting point, the need for adjustment in the tax rate should be anticipated.

Summary

The costs and benefits of each of these regulatory and tax strategies was determined by estimating their impact on the following:

(a) weight of packaging solid waste

(b) weight of major virgin materials used in the manufacture of packaging

(c) weight of additional recycled materials used

(d) energy used to produce packaging

(e) employment in the packaging industries

(f) expenditures for products

(g) consumer surplus (the difference between the price consumers pay for a product and the actual market value of the product)

(h) tax revenues (applies to the fiscal policies).

Other benefits that might result are natural resource and environmental savings, balance-of-trade improvements, and increased efficiency were not included. The administrative costs of the specific taxes or regulations were also excluded, since they were expected to be relatively small.

ANALYSIS OF POLICY INSTRUMENTS

A summary of the estimated tax payments, effectiveness, cost, and cost per unit of effectiveness of regulatory packaging material, taxing packaging weight, and taxing units of packaging, all described in the previous section, is presented in Tables 7-10. The information in these tables is based on research for the Environmental Protection Administration by T.H. Bingham and his associates and is discussed below.[15]

Regulation

Regulations are expected to result in small increases in product costs. They would raise the cost of packaging materials because recycled materials tend to be more expensive than virgin materials. But the increases would be small because raw materials inputs to packaging account for only a small share of total costs - less than 10 percent in most cases. Thus, prices would usually increase less than one percent even at the highest regulation level (30 percent). The average increase is 0.2 percent at this level.

Because of this small impact on costs, only minimal reductions in the generation of packaging wastes are projected. For the regulation requiring 30% recycled materials, the annual reduction is projected at slightly more than one percent of the total generation of packaging wastes prior to a regulation, or 285 thousand tons at 1970 rates.

Substantial increases are expected, however, for diverting municipal waste materials to recycling. For example, at 1970 rates the packaging industries were projected as using 9.1 million

tons of materials from municipal waste for recycling if the 30% regulation were in effect.

It should be noted that here, as in all the policy instruments, that the estimates of energy savings are overstated since the amount of energy used in recycling the solid waste is not included.

The annual cost to consumers due to higher prices would have averaged about $3 per capita at 1970 rates for the 30% regulation. Nationwide employment losses for this regulation level were estimated at four thousand. As in all the policy instruments, this figure does not take into account the expected increase in employment in the recycling industries.

Taxes on Packaging Weight

For all tax rates, the flat tax on gross packaging weight would bring about greater reductions in the use of packaging than would a tax which exempts recycled materials. The national difference in the reduction of packaging waste generation between the two tax structures is 50 thousand tons at a tax level of $20 per ton of packaging. At this level, the flat tax would cause a reduction of 486 thousand tons, a little under two percent of the total generation of packaging wastes prior to the tax.

With a flat tax on packaging, the only source of reductions in natural resource utilization is a reduction in the use of packaging. If recycled materials are exempted from the tax, then an additional incentive for reductions in natural resource utilization is introduced -- the substitution of recycled for virgin material inputs to packaging manufacture. At the $20 per ton of

packaging rate, the tax with the exemption for recycled materials is not expected to stop the increase in packaging. But even though more packaging waste is generated, this tax induces substantially greater reductions in virgin raw material utilization than would be expected by applying the tax without the exemption.

The prices of most consumer products would not be significantly affected by either tax, although the price increases caused by the tax with the exemption for recycled materials are smaller. Because of the smaller price increases, the loss in consumer discretionary funds is also less for the tax with the exemption.

The tax on packaging with an exemption for recycled materials has equal or lower costs per unit of effectiveness than the flat tax on packaging. This is because it promotes recycling, thus resulting in both reduced raw materials consumption and increased consumption of municipal waste materials.

Tax on Containers

A one-cent tax on all containers used to package consumer products would reduce solid waste packaging by about 9%, or 2.5 million tons at 1970 rates. Most of the reductions in packaging would be due to shifts in how packaging is used rather than reductions in the quantity of packaged products sold. As with the flat tax by total weight, reductions in natural resource consumption would for a container tax, result from the reductions in packaging consumption, not the nature of the materials used.

A unit tax of one-cent per container is expected to increase consumer prices by about 1%. The losses in consumer discretionary funds resulting from this tax rate would be over $3 billion annually.

PERSPECTIVE

The amount of consumer products packaging consumed is huge and growing annually. Besides the estimated $700 million spent on disposal of the 33 million tons of consumer products packaging discarded in 1973, the production, collection, and disposal of packaging caused high social costs in terms of both natural resource consumption and pollution.

The policy instruments discussed each produce some mix of results that appear socially preferable to the current situation. The tax on containers -- being of a significant magnitude and affecting heavy, resource-intensive packaging -- induces the largest reductions in solid waste generation and energy utilization of the policy instruments examined. Regulation requiring the use of recycled materials in packaging manufacture and a tax on packaging by weight with an exemption for recycled materials induces by incentive, should substantially increase the consumption of recycled materials and result in reductions in raw materials consumption. The flat tax on packaging by weight appears to have about the same effectiveness in reducing solid waste generation and energy utilization as the tax with the exemption for recycled materials. The flat tax, however, is estimated to be substantially less effective in reducing raw materials consumption and is ineffective in increasing the consumption of municipal waste material.

Reductions in solid waste generation and energy utilization would appear to be achieved at the lowest cost per ton and per

kilowatt-hour by using taxes. Increases in consumption of recycled materials and reductions in raw materials consumption are achieved at the lowest cost per ton by regulations requiring the use of recycled materials in packaging manufacture or by a tax on packaging with an exemption for recycled materials. Overall, the tax with an exemption for recycled materials has been predicted to provide more effectiveness at lower cost than the other three policy instruments. But effectiveness, it is recognized, may clash with equity in the making of public policy.

This paper has attempted to explain some of the major options available for controlling the generation of solid waste. Obviously, various combinations of the suggested options are possible. The policymaker must determine what objectives are desired and then determine whether the available tools make those objectives feasible.

TABLE 1. MAKEUP OF THE MUNICIPAL SOLID WASTE STREAM, 1973

Component	Discards (million tons)	Percent
Packaging	52.3	36.2
Nondurable Goods	27.9	19.4
Yard Waste	25.0	17.3
Food Waste	22.4	15.5
Durable Goods	14.7	10.2
Miscellaneous Inorganic Waste	1.9	1.3
Total	144.2	100.0

Source: League of Women Voters Education Fund. Reduce? Targets, Means and Impacts of Source Reduction. Washington: League of Women Voters of the U.S., 1975. 47p.

TABLE 2. MUNICIPAL SOLID WASTE MANAGEMENT COSTS, 1973 (million dollars)

Category	Collection Costs	Disposal Costs	Total Cost
Consumer Products Packaging	572	127	699
All Packaging	893	198	1,091
Total Waste	2,591	575	3,166

Sources: League of Women Voters Education Fund. Reduce? Targets, Means and Impacts of Source Reduction.

Bingham, T.H. et al. An Evaluation of the Effectiveness and Costs of Regulatory and Fiscal Policy Instruments on Product Packaging. Washington: U.S. Environmental Protection Agency, 1974. 301p.

TABLE 3. NATURAL RESOURCE CONSUMPTION FOR CONSUMER PRODUCT PACKAGING, 1970

Packaging Material	Raw Materials (million tons)	Energy (billion kWh)
Paper	7.96	23.50
Plastics	3.25	1.94
Glass	13.25	26.33
Steel	10.80	19.37
Aluminum	3.26	8.86
Total	44.84	80.01

Source: Bingham, T.H. et al. An Evaluation of the Effectiveness and Costs of Regulatory and Fiscal Policy Instruments on Product Packaging.

TABLE 4. PACKAGING SOLID WASTES, 1958-1970 (million tons)

ategory							Year							Average Annual Growth Rate
	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	
onsumer Products Packaging	18.3	19.6	19,7	20.6	21.6	21.8	23.0	24.0	25.6	26.8	27.9	29.6	30.6	4.39%
hipping Packaging	11.1	12.6	12.1	12.5	12.9	13.6	14.1	14.9	15.8	15.8	16.6	17.5	17.4	3.80%
otal Packaging	29.4	32.2	31.8	33.1	34.5	35.4	37.1	38.9	41.4	42.6	44.5	47.1	48.0	4.17%

ource: Bingham, T.H. et al. An Evaluation of the Effectiveness and Costs of Regulatory and Fiscal Policy Instruments on Product Packaging.

TABLE 5. PER CAPITA CONSUMPTION OF PACKAGING, 1958-1971

Year	Pounds Per Capita
1958	404.4
1966	525.0
1971	590.8

Source: 1958 and 1966 data
Darnay, Arsen and William E. Franklin. The Role of Packaging in Solid Waste Management, 1966-1976. Washington: U.S. Government Printing Office, 1967. 205p.

1971 data
Claussen, E.L. Packaging Source Reduction: Can Industry and Government Cooperate? Washington: U.S. Environmental Protection Agency, 1974. 17p.

TABLE 6. PRODUCT CONSUMPTION IN RELATION TO PACKAGING CONSUMPTION

Type of Product	Consumption (pounds per capita) 1958	1970	% Change
Dairy			
Product Consumption	398.0	354.0	-11.1
Package Consumption	10.6	13.3	+25.5
Cereals, Flour and Related Products			
Product Consumption	150.0	140.0	-6.0
Package Consumption	0.8	0.9	+12.5
Produce			
Product Consumption	90.2	80.0	-11.3
Produce Consumption	5.3	7.3	+37.7

Source: Office of Solid Waste Management Programs, U.S. Environmental Protection Agency. Second Report to Congress on Resource Recovery and Source Reduction. Washington: U.S. Government Printing Office, 1974. 112p.

TABLE 7. EFFECTIVENESS AND COSTS OF REGULATION REQUIRING THE USE OF RECYCLED MATERIALS

	Recycling Regulation (percentage recycled materials as a share of packaging weight) 10	20	30
Effectiveness			
Reductions in the consumption of packaging (%)	0.3	0.6	0.9
Reductions in solid waste generation(thousand tons)	96	191	285
Reductions in raw materials consumption(1,000 tons)	4,618	9,204	13,760
Reductions in energy utilization(million kWh)	247	494	740
Increases in consumption of municipal waste materials(thousand tons)	3,057	6,093	9,116
Cost			
Losses in consumer surplus(million dollars)	216	431	645
Increases in consumer product prices(percent)	0.07	0.14	0.20
Reductions in packaging industry employment(1,000)	1	3	4
Cost Per Unit Effectiveness			
Reductions in solid waste generation($ per ton)	2,252	2,260	2,260
Reductions in raw materials consumption($ per ton)	47	47	47
Reductions in energy utilization($ per 1,000 kWh)	874	872	872
Increases in consumption of municipal waste materials($ per ton)	70.8	70.8	70.8

Source for Tables 7-10: Bingham, T.H., et al, *An Evaluation of the Effectivenes and Costs of Regulatory and Fiscal Policy Instruments on Product Packaging.*

TABLE 8. EFFECTIVENESS AND COSTS OF TAX ON PACKAGING

	Tax Rate (dollars per ton)			
	9	20	45	90
ax Payments(million dollars)	273	597	1,337	2,582
fectiveness				
Reductions in consumption of packaging(percent)	0.7	1.6	3.7	7.5
Reductions in solid waste generation(thousand tons)	222	486	1,089	2,127
Reductions in raw materials consumption(thousand tons)	301	658	1,485	2,895
Reductions in energy utilization(equivalent million kWh)	529	1,157	2,596	5,078
ost				
Losses in consumer surplus(million dollars)	274	598	1,338	2,599
Increases in consumer product prices(percent)	0.1	0.2	0.4	0.8
Reductions in packaging industry employment(thousand)	3	7	15	30
ost Per Unit Effectiveness				
Reductions in solid waste generation(dollars per ton)	1,237	1,230	1,229	1,222
Reductions in raw materials consumption(dollars per ton)	910	909	901	897
Reductions in energy utilization(dollars per 1,000 kWh)	518	517	515	512

TABLE 9.

FECTIVENESS AND COSTS OF TAX ON PACKAGING WITH EXEMPTION FOR RECYCLED MATERIALS

	Tax Rate (dollars per ton)			
	9	20	45	90
ax Payments(million dollars)	237	472	913	1,670
ffectiveness				
Reductions in consumption of packaging(percent)	0.7	1.4	2.9	5.3
Reductions in solid waste generation(thousand tons)	218	435	863	1,545
Reductions in raw materials consumption(thousand tons)	5,378	8,441	13,982	17,350
Reductions in energy utilization(equivalent million kWh)	518	1,031	2,050	3,675
Increases in consumption of municipal waste(1,000 tons)	4,291	6,514	9,634	10,693
st				
Losses in consumer surplus(million dollars)	268	531	1,062	1,906
Increases in consumer product prices(percent)	0.1	0.2	0.3	0.6
Reductions in packaging industry employment(thousand)	3	6	11	20
st Per Unit Effectiveness				
Reductions in solid waste generation(dollars per ton)	1,229	1,220	1,230	1,23
Reductions in raw materials consumption(dollars per ton)	50	64	76	110
Reductions in energy utilization(dollars per 1,000 kWh)	517	515	518	519
Increases in consumption of municipal waste($ per ton)	63	82	110	178

TABLE 10. EFFECTIVENESS AND COSTS OF TAX ON CONTAINERS

	Tax Rate(¢ per container)			
	½	1	1½	2
ax Payments(million dollars)	1,651	3,138	4,622	6,073
ffectiveness				
Reductions in consumption of packaging(percent)	5.9	9.1	11.1	13.0
Reductions in solid waste generation(thousand tons)	1,707	2,553	3,048	3,508
Reductions in raw materials consumption(thousand tons)	2,149	3,327	4,098	4,863
Reductions in energy utilization(million kWh)	3,897	5,596	7,287	8,530
ost				
Losses in consumer surplus(million dollars)	1,652	3,160	4,685	6,200
Increases in consumer product prices(percent)	0.5	1.0	1.5	2.0
Reductions in packaging industry employment(thousand)	15	25	33	41
ost Per Unit Effectiveness				
Reductions in solid waste generation(dollars per ton)	967	1,238	1,537	1,768
Reductions in raw materials consumption(dollars per ton)	769	950	1,143	1,275
Reductions in energy utilization(dollars per 1,000 kWh)	424	531	643	727

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